REMARKS

Claims 1-22 are pending in this application. Claims 1-22 are rejected. Claims 1, 14 and 19 have been amended. No new matter has been added. It is respectfully submitted that the pending claims define allowable subject matter. This Amendment is being filed in connection with a Request for Continued Examination.

Claims 1-3, 5-10, 12 and 14-18 have been rejected under 35 U.S.C. § 102(e) as being anticipated by Koch et al. (U.S. Patent 6,960,879). Applicant respectfully traverses the 35 U.S.C. § 102(e) rejection.

Koch et al. describes a system for correcting distortion of an image intensifier including means for projecting onto a primary screen a location test pattern (abstract). More particularly, an intensifier includes means for projecting a location test pattern onto a primary screen 4. These means may include, for example, a window 16 located in an envelope 3. The window allows radiation 17, different from X-radiation, to illuminate the primary screen 4. The window 16 is positioned on the envelope 3 in such a way that the radiation 17 can illuminate approximately the entire surface of the primary screen 4. The window 16 is located in such a way that the radiation 17 illuminates the primary screen 4 on the opposite face from that which receives the X-radiation (column 3, lines 18-32).

An optical device includes a source 21 that emits the radiation 17. The source 21 is advantageously monochromatic and focused by means of a lens 22 onto the primary screen 4. To produce the source 21, a solid-state laser may be used, such as a pointer. The wavelength of the laser is chosen so that the photocathode 11 is sensitive at this wavelength. The beam of radiation 17 thus focused is reflected off the surface of a diffraction grating 23 in order to be sent onto the primary screen 4 onto which the radiation 17 is focused (column 3, lines 40-50). The means 16 may comprise a prism 30 with the diffraction grating 23 placed on a third face 33 of the prism 30. The diffraction grating 23 may be produced directly on the face 33 of the prism 30. The diffraction grating 23 also may be produced on a substrate 34 separate from the prism 30. The substrate 34 is then cemented to the face 33 using an optical cement 35 of the same optical index as the prism 30. This same cement may also be used to cement the face 32 of the prism 30 to the window 16 (column 3, lines 51-67).

The diffraction grating 23 may, for example, be produced using a periodic pattern or holography with t he source 21 is rigidly fixed to the envelope 3. It is also possible to use a part 44 of the secondary screen 5 as a window for introducing the radiation 17 into the envelope 3. This part is then made transparent to the radiation 17. For example, when the secondary screen 5 has a phosphor-based scintillator material intended to convert the electrons emitted by the photocathode 11 into visible radiation, the phosphor is removed from the secondary screen in the part 44 so as to allow the radiation 17 to penetrate the envelope 3. The source 21 is located near the secondary screen and a prism 40 is used, for example, to send the radiation 17 onto the primary screen 4 Column 4, lines 1-23).

The image intensifier also includes means for analyzing the distribution of the plurality of points of the location test pattern 41 that are received by the secondary screen 5. The distortion is measured by analyzing the distribution of the points in the image 42 of the location test pattern 41. The measurement may be absolute and the analysis includes comparing the distribution of points in the image 42 relative to a theoretical distribution. The measurement may be relative and, in this case, the comparison is made relative to an image 42 produced in a calibration phase during which the distortion of the image is controlled (column 4, lines 42-57).

Claim 1, as amended, recites a method for calibrating an X-ray imaging system comprising "determining an image distortion of the X-ray imaging system based upon a plurality of samplings of the calibration image for calibrating the X-ray imaging system". Koch et al. fails to describe or suggest a method as recited in amended claim 1. In particular, the system of Koch et al. compares the distribution of a plurality of points of a location test pattern to one of a relative theoretical distribution of points in an image or to an image produced in a calibration phase. However, Koch et al. fails to describe or suggest determining image distortion based on a plurality of samplings of a calibration image. Thus, less accurate distortion correction may result. Accordingly, Koch et al. does not describe or suggest a method as recited in claim 1.

Claims 2, 3, 5-10 and 12 depend from independent claim 1. When the recitations of claims 2, 3, 5-10 and 12 are considered in combination with the recitations of claim 1, Applicant submits that dependent claims 2, 3, 5-10 and 12 are likewise patentable over Koch et al. for at least the same reasons set forth above.

Claim 14, as amended, recites a method for determining distortion in an X-ray imaging system comprising "comparing to the light pattern output of the calibration image source a plurality of outputs produced by the image intensifier that are interpolated." Koch et al. fails to describe or suggest a method as recited in amended claim 14. As discussed in more detail above in connection with claim 1, the system of Koch et al. simply does not compare a plurality of outputs produced by an image intensifier to a light pattern output of the calibration image source. Additionally, although the system of Koch et al. may use interpolation to determine distortion for a point in question in an image, the system does not interpolate a plurality of outputs produced by the image intensifier and compare the outputs to a light pattern output. Accordingly, Koch et al. does not describe or suggest a method as recited in claim 14.

Claims 15-18 depend from independent claim 14. When the recitations of claims 15-18 are considered in combination with the recitations of claim 14, Applicant submits that dependent claims 15-18 are likewise patentable over Koch et al. for at least the same reasons set forth above.

For at least the reasons set forth above, Applicant respectfully requests that the 35 U.S.C. § 102(e) rejection of claims 1-3, 5-10, 12 and 14-18 be withdrawn.

Claims 4, 13 and 19-22 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Koch et al. in view of Quadflieg et al. (U.S. Patent 6,086,252). Applicant respectfully traverses the 35 U.S.C. § 103(a) rejection.

Koch et al. is described above.

Quadflieg et al. describes a system for correction of a fixed pattern noise wherein an X-ray image intensifier is provided with a radiation source such as flashlights or LEDs (abstract). Radiation sources 4 are mounted inside an X-ray image intensifier 1. The radiation sources 4 irradiate a photocathode with radiation whereto the photocathode is sensitive. The radiation from the radiation sources 4 may have a wavelength near the wavelength of the radiation generated by a conversion layer. The radiation sources 4 may be flashlights or light-emitting diodes. The radiation sources are arranged such that they emit radiation beams 20 which cover substantially the entire area of the photocathode 3, at a side that is remote from the conversion layer 10, with a spatially uniform intensity. A television camera 15 derives a calibration signal from the light intensity distribution on the exit window

12. Ideally, if there are no perturbations, the uniform intensity distribution generated by the radiation source 4 leads to a uniform light intensity on the exit window and the calibration signal has a constant signal level. The actual calibration signal that is derived from the uniform intensity distribution represents the combined effect of different perturbations that are introduced by irregularities in the photocathode, the electron optics, the exit window with its phosphor layer, the optical coupling 16 from the exit window 12 to the television camera 15 and the television camera 15 itself. The calibration signal can be formed just before or after, within a few seconds, of the formation of an X-ray image of the patient (column 6, lines 18-51).

Further, the television camera 15 derives the primary image signal from a light-optical image. The primary image signal is supplied in the form of an electronic video signal. The electronic video signal has signal levels that represent the brightness at respective positions in the light-optical image on the exit window. The output port of the television camera is coupled to a signal correction unit 30. The signal correction unit 30 generates a corrected image signal. The signal correction unit 30 is coupled to a monitor 25 or to a buffer unit 26. The image information of the X-ray image is displayed on the monitor 25. The corrected image signal may also be applied to the buffer unit 26 and be further processed later or be printed as a hard-copy (column 6, lines 52-65).

The signal correction unit 30 corrects the primary image signal for perturbations introduced in the conversion of the low-energy radiation image from the conversion layer 10 into the primary image signal. To that end the signal correction unit 30 comprises a multiplier 31 that multiplies the primary image signal by correction numbers. The correction numbers are stored in a memory unit 32. In order to carry-out accurate correction, the radiation sources 4 are briefly activated by a control unit 33, just before or after the actual X-ray image of the patient is formed. The radiation sources 4 mutually illuminate the photocathode 3 with a substantially uniform intensity distribution, i.e., the calibration low-energy radiation intensity distribution. As a consequence the television camera 15 generates the calibration signal that is fed to the signal correction unit 30. The calibration signal is applied to an arithmetic unit 34 via a switching unit 35. The switching unit is operated by the control unit 33. The arithmetic unit 34 derives the maximum signal level from the calibration signal and calculates the respective ratios of the signal levels to the maximum signal level. These ratios form the correction numbers that are stored in the

memory unit 32. Any deviations of the correction numbers from unity represent perturbations. When the memory unit 32 is updated with accurate correction numbers, the control unit operates the switching unit 35 in order to apply the primary image signal to the multiplier 31. The perturbations in the primary image signal are removed by multiplying the primary image signal by the correction numbers, i.e., multiplying respective signal levels of the primary image signal by respective correction numbers (column 7, lines 16-45).

Claims 4 and 13 depend from independent claim 1. Applicant submits that Quadflieg et al. fail to make up for the deficiencies of Koch et al. as Quadflieg et al. describes a system that determines correction numbers based on ratios of signal levels from a light-optical image. Accordingly, when the recitations of claims 4 and 13 are considered in combination with the recitations of claim 1, Applicant submits that dependent claims 4 and 13 are likewise patentable over the combination of Koch et al. in view of Quadflieg et al. for at least the same reasons set forth above with respect to claim 1.

Claim 19, as amended, recites a system for determining distortion within an X-ray imaging device comprising "a calibration image source within an image intensifier configured to generate a calibration image pattern at an output of the calibration image source for use in determining distortion within the X-ray imaging device based on a plurality of samplings of a correction image generated from the calibration image pattern." The combination of Koch et al. in view of Quadflieg et al. fails to describe or suggest a system as recited in amended claim 19. The combination does not describe or suggest a system that generates a calibration image pattern at an output of a calibration image source for use in determining distortion within the X-ray imaging device based on a plurality of samplings of a correction image generated by the calibration image pattern. The system of Koch et al. compares the distribution of a plurality of points of a location test pattern to one of a relative theoretical distribution of points in an image or to an image produced in a calibration phase. The system of Quadflieg et al. determines correction numbers based on ratios of signal levels from a light-optical image. There is simply no description or suggestions of using a plurality of samplings. Accordingly, the combination of Koch et al. in view of Quadflieg et al. does not describe or suggest a system as recited in claim 19.

Claims 20-22 depend from independent claim 19. When the recitations of claims 20-22 are considered in combination with the recitations of claim 19, Applicant

submits that dependent claims 20-22 are likewise patentable over the combination of Koch et al. in view of Quadflieg et al. for at least the same reasons set forth above.

Claim 11 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Koch et al. in view of Pradere et al. (U.S. Patent 6,194,700). Applicant respectfully traverses the 35 U.S.C. § 103(a) rejection.

Koch et al. is described above.

Pradere et al. describes a device with alteration means for conversion of an image using an image intensifier tube by providing a permanent test pattern on the intensifier tube, and more particularly, at an input window of the intensifier tube (abstract). In a first exemplary embodiment, to make the references of one test pattern, a support 20 comprises deformations 23. For example, the deformations 23 are grooves or holes (not through holes) located on the face of the support 20 which receives the radiation 17. At the position of these holes, the absorbent capacity of the support 20 is reduced. The result thereof is a modification of the image formed on the target 6. As a first variant, these hollow deformations 23 are replaced by other hollow deformations 24 made on the face of the support 20 in between this support 20 and the scintillator 19 (or the photocathode 5 which is curved). In this first variant, the resulting reduction of absorption is increased by the deformation, as the case may be, of the growth of CsI at this place. The resulting spot of the image is therefore increased. In a second variant, an input window 25 of the tube 4, formed by the part of the envelope 4 of the tube that faces the input face 18, comprises grooves or holes 26 fulfilling the same role as the holes or grooves 23 and 24 (column 4, lines 41-60). Further, the deformations may be replaced by deformations acting in the negative sense. For example, protuberances 27 may be made on the face of the support 20 that receives radiations 27. These protuberances may also be made on the internal face of the window 25 of the tube 4 (column 5, lines 1-6).

In another method for obtaining the test pattern, a window 28 is provided in the envelope 4 of the tube. The window 28 is outside the field of radiation to be converted. Through this window 28, a laser radiation 29 (essentially a single ray, especially if the source is not a laser source), produced for example by a laser source 30, illuminates the rear face of the photocathode 5. Under the effect of this illumination, the photocathode 5 emits an electron radiation 31 revealing the place where it has been excited by the ray 29. It is

possible to obtain a scanning of the rear of the photocathode 5 through the ray 29. Preferably, the emission of the source 30 is pulsed (column 5, lines 25-36). Further, rather than illuminate the photocathode 5 by the rear, auxiliary light radiation may be let through by means of through holes 32 made throughout the thickness of the support 20 (column 5, lines 55-58). Additionally, a third mode of implementation comprises the making of a grid 33 whose shape perfectly matches the spherical shape of the input window 25. This grid 33 may slide in alternation on the input window 25. The principle of acquisition with this third mode consists in mobilizing the grid, for example making it shift during the useful shot. In this case, bars 34 of the grid 33 distribute their absorption effect throughout the image which is thereby affected uniformly. At the time of acquisition of the image of the test pattern, it is constituted by the grid 33 stopped in a particular position (column 5, line 59 to column 6, line 2).

In operation, an image obtained of the test pattern is memorized in a memory 43 of the image processor 14. This memorized image is, for example, a file registering a collection of addresses, x-axis values and y-axis values corresponding to the points of the grid forming the test pattern. At the time of use, an acquisition is made alternately (or at the same time) of the useful image, that of the patient 2, and that of the test pattern. These images comprise identical deformations. Owing to the position in space of the tube 4 and the disturbances communicated to the tube 4, in this position, by the earth's magnetic field, the grooves 44, 45 made on this test pattern get converted into images 46 and 47, respectively, on the target 6. The resultant deformations are comprehensively S-shaped deformations. The point 48 of concurrence of the grooves 44 and 45, whose position is known by the memory 43, has shifted to the position 49. The processor 14 is capable of processing the image to prepare the coordinates of the images 49 of the points of concurrence 48. Starting from the perfect image of the test pattern stored in the memory 43 and the image, acquired in real time, of the test pattern, the processor 14 performs a comparison 50 and produces a reverse distortion function 51. This reverse distortion function 51 is then applied to the useful image 52 of the patient 2 to produce the corrected image 53 by correction (column 7, lines 6-33).

Claim 11 depends from independent claim 1. Applicant submits that Pradere et al. fail to make up for the deficiencies of Koch et al. Pradere et al. describes a system that starts from a perfect image of a test pattern stored in memory and the image, acquired in real time, of the test pattern, and a processor performs a comparison and produces a reverse

distortion function. The reverse distortion function is then applied to the useful image of a patient to produce the corrected image. Accordingly, when the recitations of claim 11 are considered in combination with the recitations of claim 1, Applicant submits that dependent claim 11 is patentable over the combination of Koch et al. in view of Pradere et al. for at least the same reasons set forth above with respect to claim 1.

For at least the reasons set forth above, Applicant respectfully requests that the 35 U.S.C. § 103(a) rejection of claims 4, 11, 13 and 19-22 be withdrawn.

In view of the foregoing amendments and remarks, it is respectfully submitted that the prior art fails to teach or suggest the claimed invention and all of the pending claims in this application are believed to be in condition for allowance. Reconsideration and favorable action is respectfully solicited. Should anything remain in order to place the present application in condition for allowance, the Examiner is kindly invited to contact the undersigned at the telephone number listed below.

Respectfully Submitted,

Evan R. Sotiriou, Reg. No.: 46,247
ARMSTRONG TEASDALE LLP
One Metropolitan Square, Suite 2600
St. Louis, Missouri 63102-2740
(314) 621-5070